Chapter 3: Framing

Framing Methods

The *Washington State Energy Code* (WSEC) recognizes three types of wall framing methods: Standard, Intermediate and Advanced.

Standard Framing is defined as studs framed on 16-inch centers with double top plate and single bottom plate. Corners use three studs and each opening is framed using two studs. Headers consist of double 2x or single 4x material with an air space left between the header and the exterior sheathing. Interior partition wall/exterior wall intersections use two studs in the exterior wall.

Intermediate Framing is defined as studs framed on 16-inch centers with double top plate and single bottom plate. Corners use two studs or other means of fully insulating corners and each opening is framed by two studs. Headers consist of double 2x material with R-10 insulation between the header and exterior sheathing. Interior partition wall/ exterior wall intersections are fully insulated in the exterior wall. Although the WSEC defines "Intermediate Framing" as having the headers insulated between the header and the sheathing, a "sandwich" header may be a preferred option. A sandwich header provides a nailing surface on both the inside and the outside for attaching siding, sheetrock and trim (see Figure 3-14). Interior partition wall/exterior wall intersections are fully insulated in the exterior wall.

Advanced Framing is defined as studs framed on 24-inch centers with double top plate and single bottom plate. Corners use two studs or other means of fully insulating corners and one stud is used to support each header. Headers consist of double 2x material with R-10 insulation between the header and exterior sheathing. Sandwich headers are common using advanced framing techniques.

Intermediate Framing Materials. Most prescriptive options require intermediate wall framing. Credit for the added thermal efficiency gained by advanced framing is also allowed if a project follows the component performance or systems analysis approach. To meet the requirements of intermediate wall framing, installation of foam insulation for headers is required (see Figure 3-14).

Advanced Framing Materials. If you're planning to do advanced wall framing, be sure to order sheathing, siding, and wallboard rated for a 24-inch on-center framing.

The WSEC does not require advanced framing for walls, but will credit the added thermal efficiency gained by advanced framing if your project follows a component performance or systems analysis approach (see pages 1-7 and 1-11).

Advanced Framed Ceilings. The WSEC requires "advanced" roof/ceiling framing for some prescriptive paths and will credit the added thermal efficiency gained by advanced framing if your project follows the component performance or systems analysis approach. Advanced framing is defined as having full and even depth insulation extending to the outside edge of exterior walls. This may be accomplished by using a raised heel truss, using an oversized truss or using a high R-value foam product at the wall line (see figure 3-15).

Windows. Before you order or install windows, make sure the windows meet Code requirements (see Chapter 1).

Heat loss through windows, per square foot, is very high compared to most other building envelope components. Decisions about window type, glazing area, and orientation can be the most important energy performance choices you make for the home.

U-Factors are a measure of window energy performance. The lower the U-factor, the lower the rate of heat transfer, and the better the energy performance of the window. The total window area and the area weighted U-factor (see page 1-4) for all windows must meet the compliance path chosen. Always check with your building jurisdiction before adding additional windows or changing window

type. Unapproved changes may result in unnecessary construction delays while compliance is reverified.

All windows and skylights should be tested to establish U-factors. Only National Fenestration Rating Council (NFRC) Standard 100-2004 test results from a certified laboratory will be acceptable. NFRC Residential Model Size must be used. If a test result is not available, you must use the appropriate default U-factor listed in the Code for Compliance (see WSEC Table 10-6A and Table 10-6B).

Solar heat gain coefficient (SHGC) will also be needed if a Systems Analysis Approach is being utilized.

For more information on NFRC labeling, visit the Efficient Windows Collaborative web site:
www.efficientwindows.org/nfrc.html

> **Note:** The Code considers a sliding glass door a window.

Some windows may require special jamb extensions because of added wall thickness needed to accommodate required insulation levels.

Exterior Doors. The following doors must meet the chosen compliance path required U-factor for exterior doors:

- Entry doors.
- Garage passage doors.
- Interior doors to unheated basements.
- Doors joining any heated space with an unheated space.
- One swinging door of not more than 24 square feet may be exempted from the door U-factor requirement.

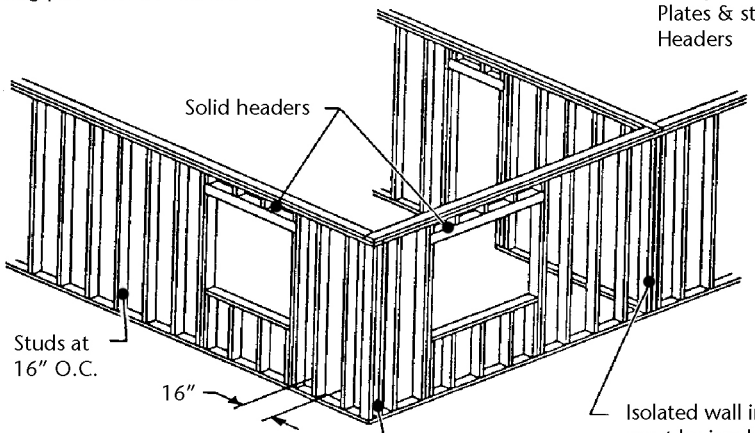
[502.1.5.2, Exception 3]

Figure 3-1

Standard, Intermediate, and Advanced Framing

Standard Framing

Framing placed at 16″ on center



Standard Framing	
Cavity	77%
Plates & studs	19%
Headers	4%

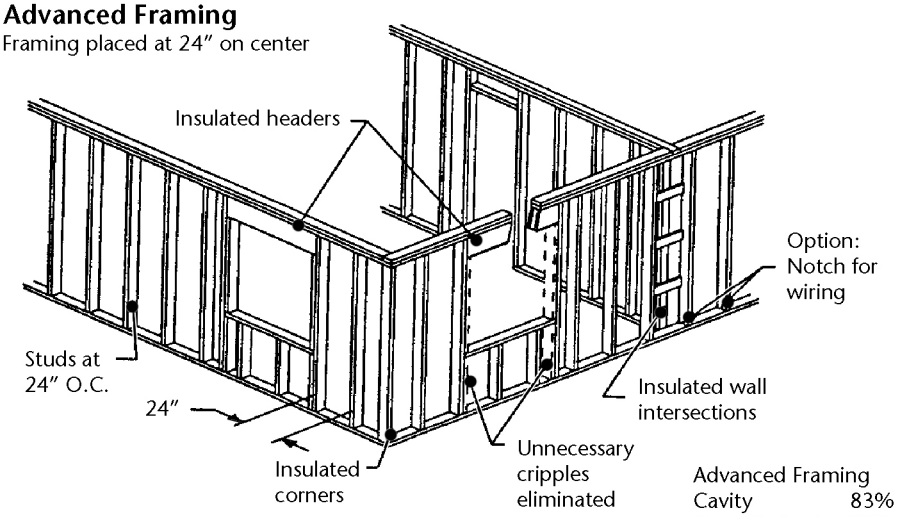
Intermediate Framing

Framing placed at 16″ on center
Insulated headers, corners and intersections

Intermediate Framing	
Cavity	78%
Plates & Studs	18%
Headers	4%

Advanced Framing

Framing placed at 24″ on center



Advanced Framing	
Cavity	83%
Plates & Studs	13%
Headers	4%

Note: Approximately 25% less wood in advanced frame walls.

If a tested value for the door assembly you plan to use is not available, then use the default values in WSEC Table 10-6C.

> **Note:** The area of glazing that is part of any swinging door is included in the total glazing area of the house as determined for prescriptive compliance. The U-factor of this door glazing, however, is counted as part of the doors overall U-factor (see WSEC Table 10-6C).

Skylights. Skylights are included in the total glazing percentage for the home. Skylights must meet U-factor requirements specific to overhead glazing. Default U-factors for overhead glazing are listed in WSEC Table 10-6E.

Energy-Efficient Floor Framing

Framed floors over unconditioned space must be able to accommodate the levels of insulation required (see Chapter 4 for insulation details).

[502.4.3] **Sealing Air Leaks.** The WSEC requires that all openings, joints, and penetrations in the thermal envelope of the building must be sealed, caulked, gasketed or weatherstripped to limit air leakage.

The first floor rim joist area over a basement and the rim joist area between floors may require special attention during framing (see Figures 3-2, 3-3 and Chapter 5, Air Leakage and Moisture Control).

[502.1.6.2] **Vapor Retarders.** Floors over unconditioned space must include a vapor retarder. Manufactured flooring materials (plywood, etc.) with exterior grade glues meet this requirement. Flooring systems such as 2x6 decking that do not include plywood or similar materials must use kraft paper, poly sheathing or some other rated material as a vapor retarder (see Figure 3-4).

Figure 3-2

Basement Rim Air Barrier

[502.4.3]

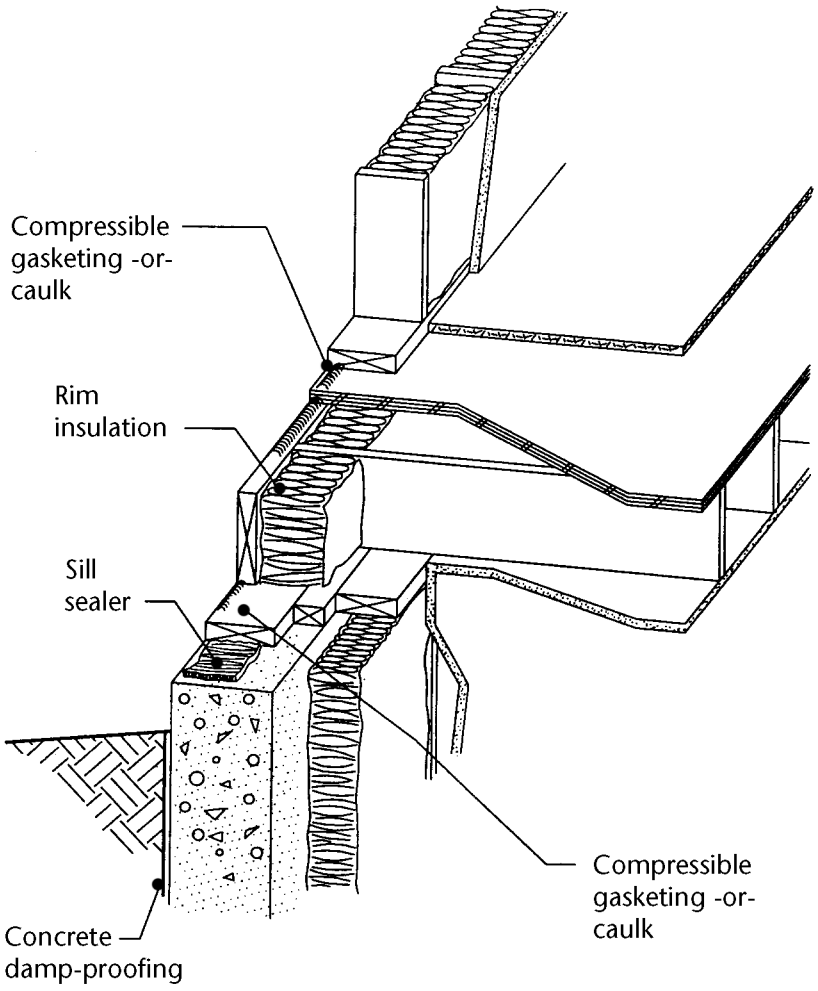


Figure 3-3

Standard Rim Air Barrier

[502.4.3]

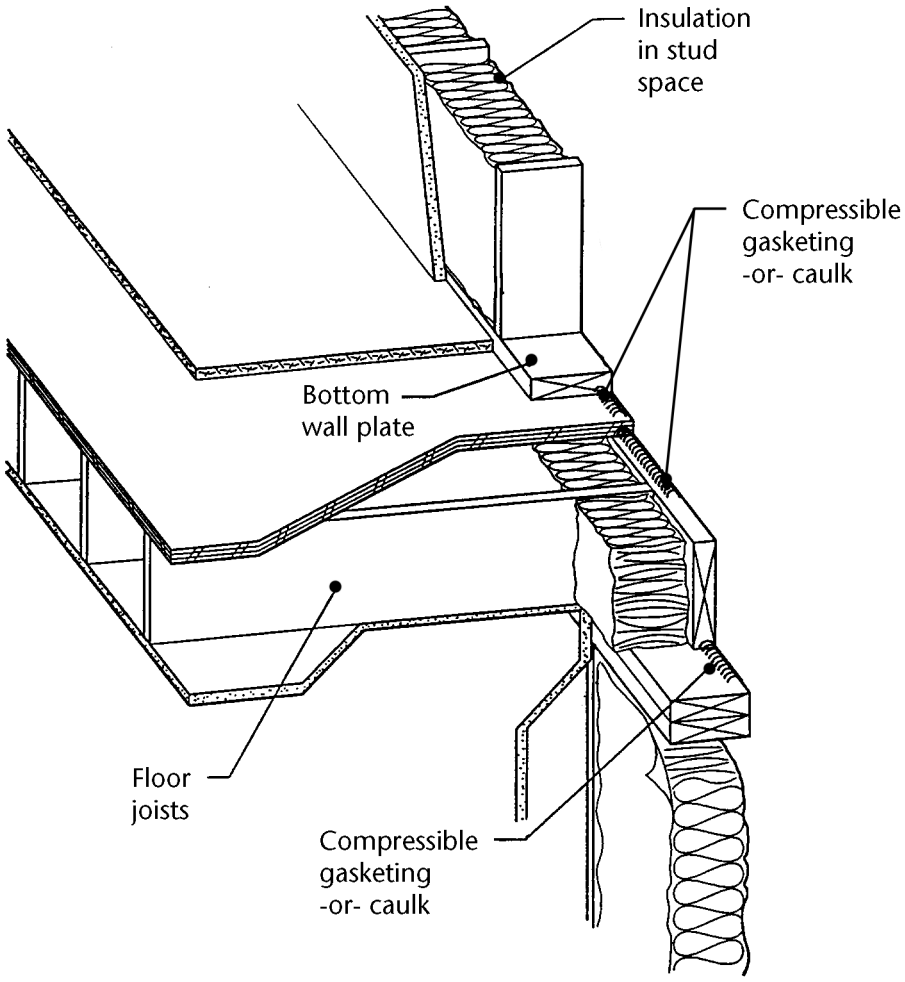
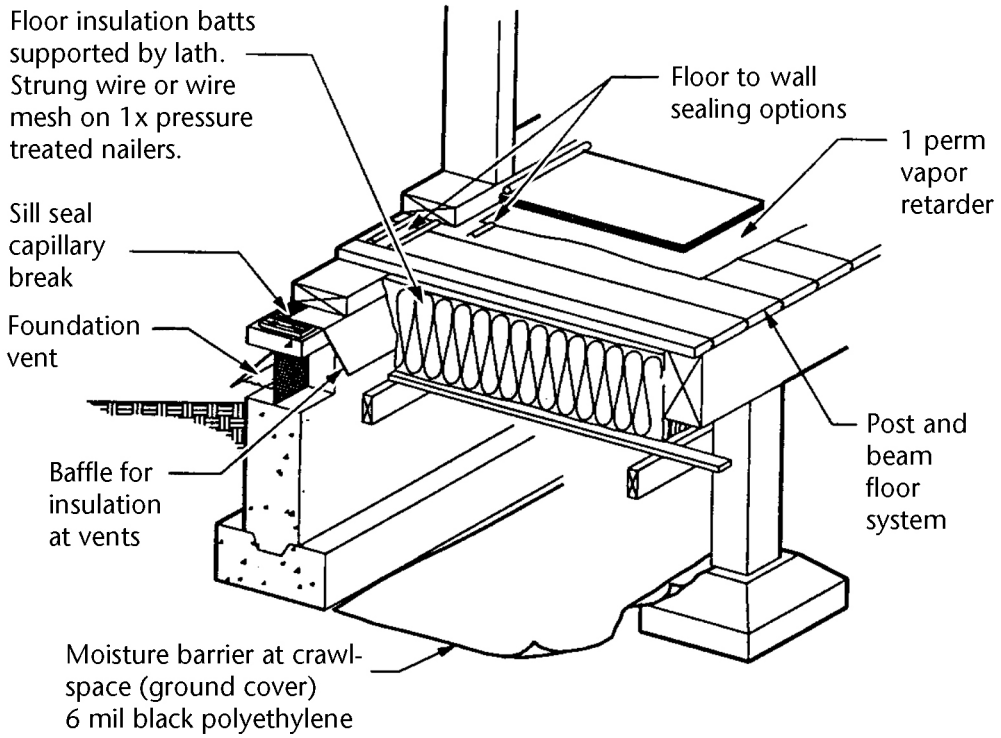


Figure 3-4

Post and Beam Air Sealing



Energy-Efficient Wall Framing

You may use any wall detail that has an insulation nominal R-value equal to or exceeding your chosen compliance path (see Figure 3-5 and Chapter 1).

[602.2] **Wall Details.** The Prescriptive Approach identifies four alternatives as equivalent to the nominal R-21 wall (see Figures 3-5 and 3-6). In addition, the Component Performance and Systems Analysis Approaches credit the use of higher R-value walls (see Figure 3-7). The use of double framed walls or stressed-skin panels are among other options that may work (see Figure 3-8).

Insulated Sheathing. Insulated sheathing may be used to increase the R-value of a wall. Insulated sheathing can be used to meet the requirements in Prescriptive Paths II and III in Table 6-2. If the insulated sheathing is used in place of structural sheathing, additional wall bracing will be required. Consult the *International Residential Code* (IRC) for bracing requirements in your area.

Rigid foam insulation may be applied to either the interior or exterior surface of the exterior wall (see Figures 3-9, 3-10 and 3-11). Applying foam to the exterior is the preferred option.

Additional references, prepared by the APA Engineered Wood Association, may also be useful. Check the various resources available on the APA website: ***www.apawood.org***

Insulation. The Code requires all cavities in the thermal envelope of the building be filled with insulation. Corners and wall intersection can easily be filled during the normal placement of wall insulation using certain details (see Figures 3-12 and 3-13).

Headers. Headers must always be properly sized to meet loading conditions. All Prescriptive Path Options in Climate Zone 1 and Prescriptive Path Option 1 in Climate Zone 2 require Intermediate framed walls. Intermediate wall framing requires R-10 insulated headers unless structural requirements specify a 6x header.

Figure 3-5

Acceptable R-21 Walls

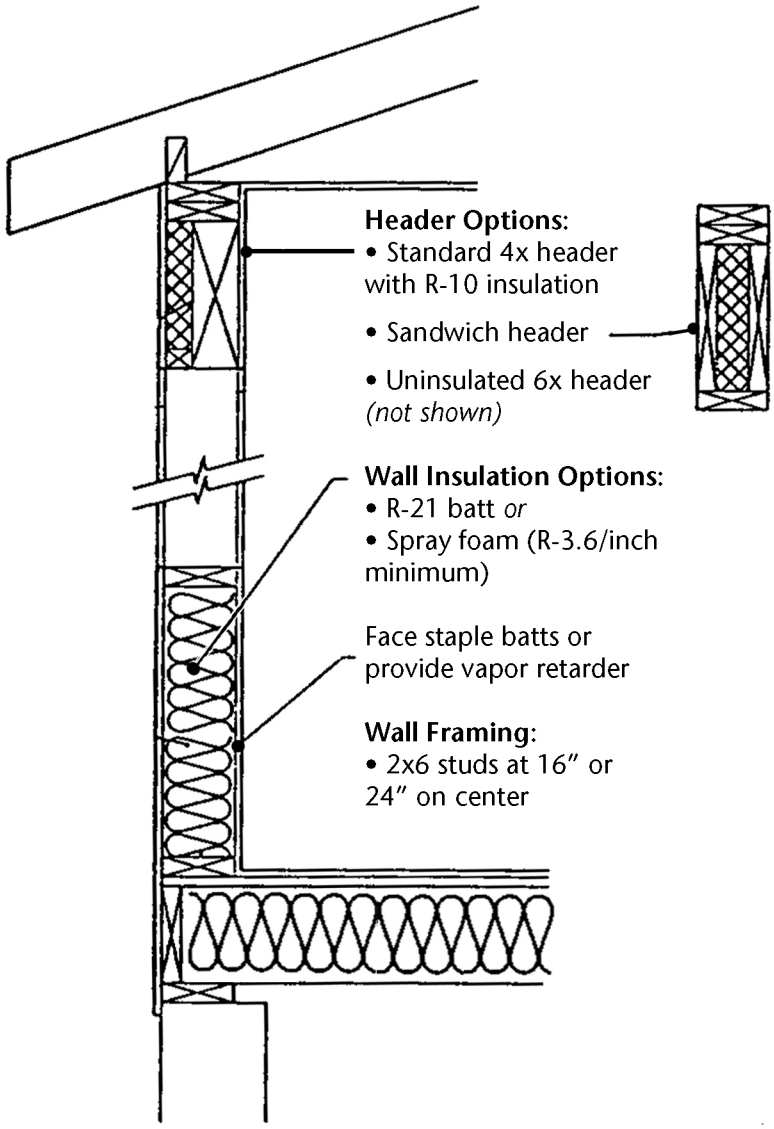
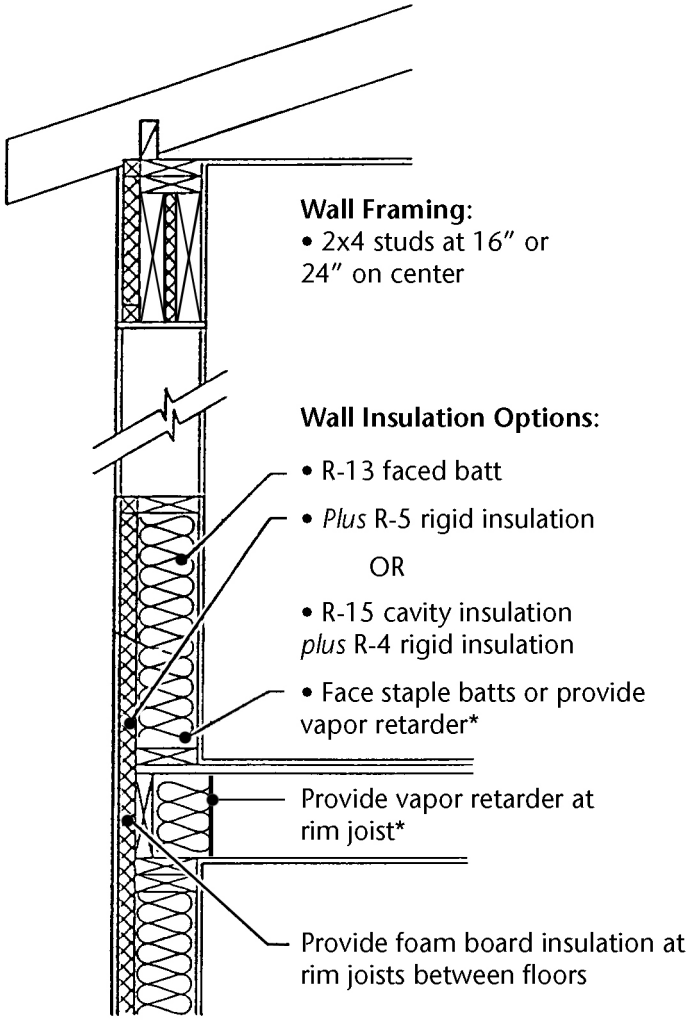


Figure 3-6

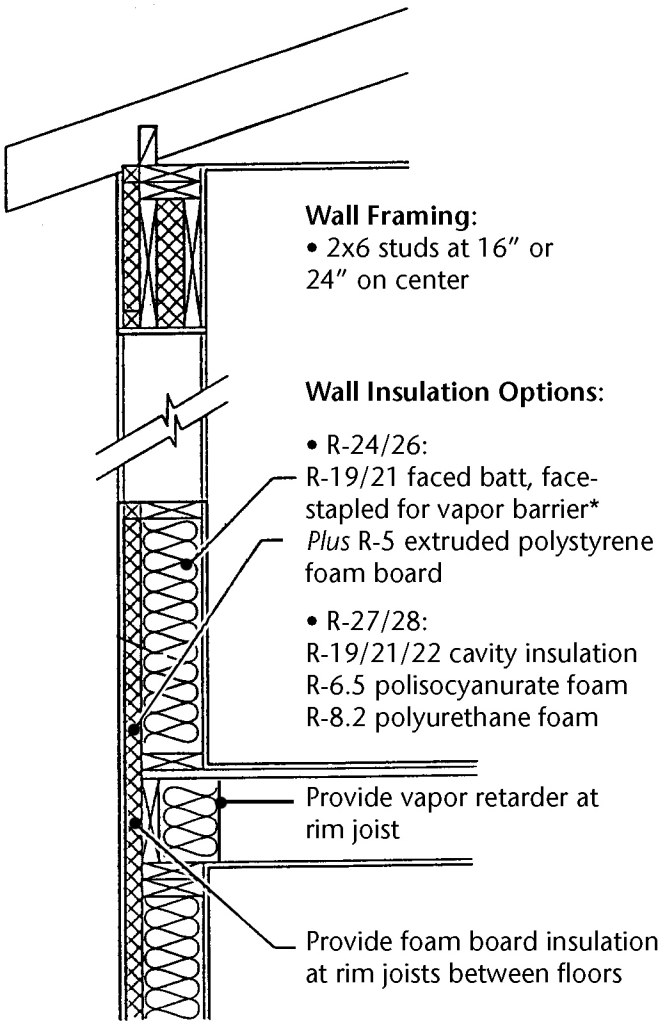
Acceptable Prescriptive Substitutes for R-21 Walls



** Vapor retarder is not required if R-5 rigid insulation is installed in Climate Zone 1 (R-7.5 for Climate Zone 2).*

Figure 3-7

R-24 & Above Walls



** Vapor retarder is not required if R-5 rigid insulation is installed in Climate Zone 1 (R-7.5 for Climate Zone 2).*

Figure 3-8

Double Wall

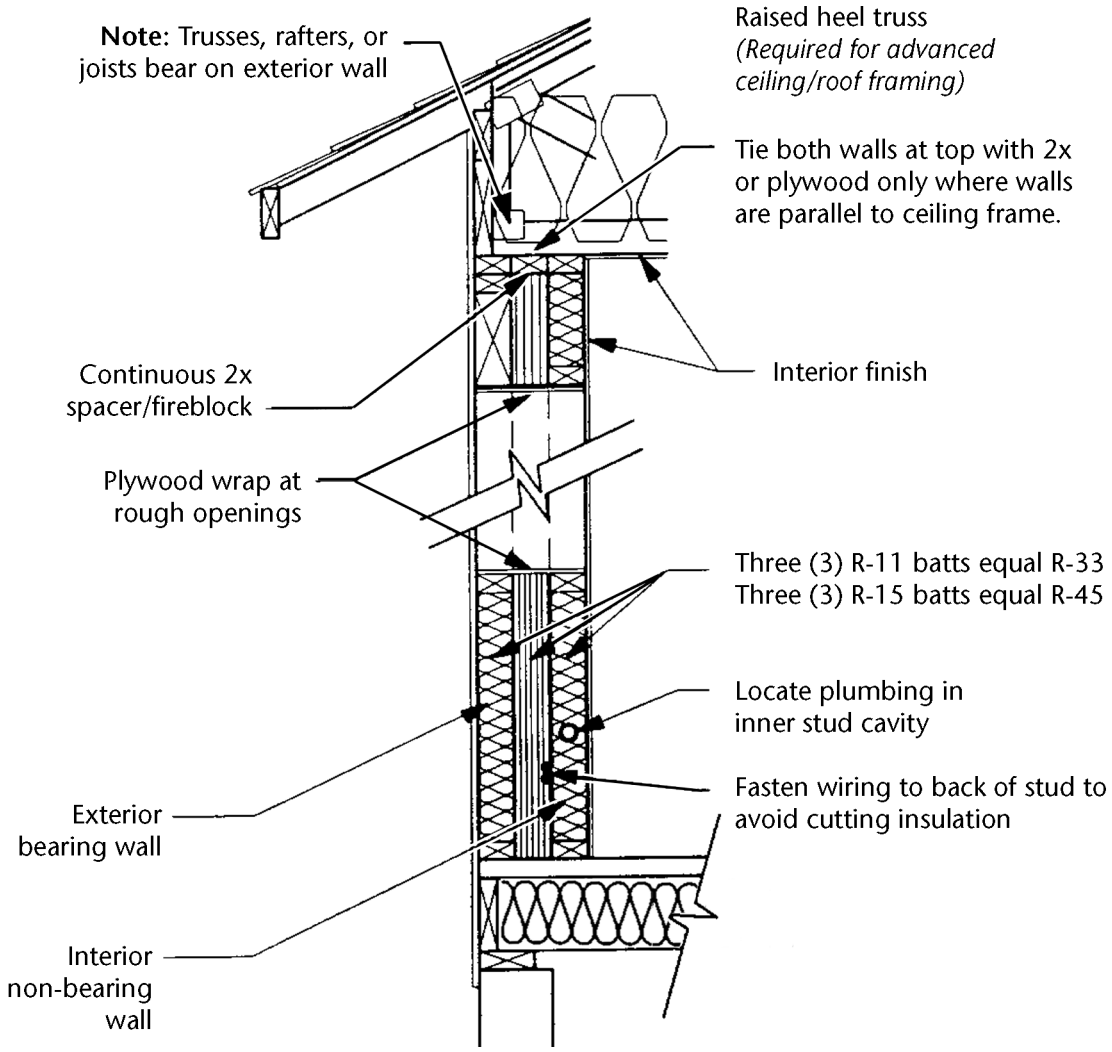


Figure 3-9

Above-Grade Wall: Interior Rigid Insulation

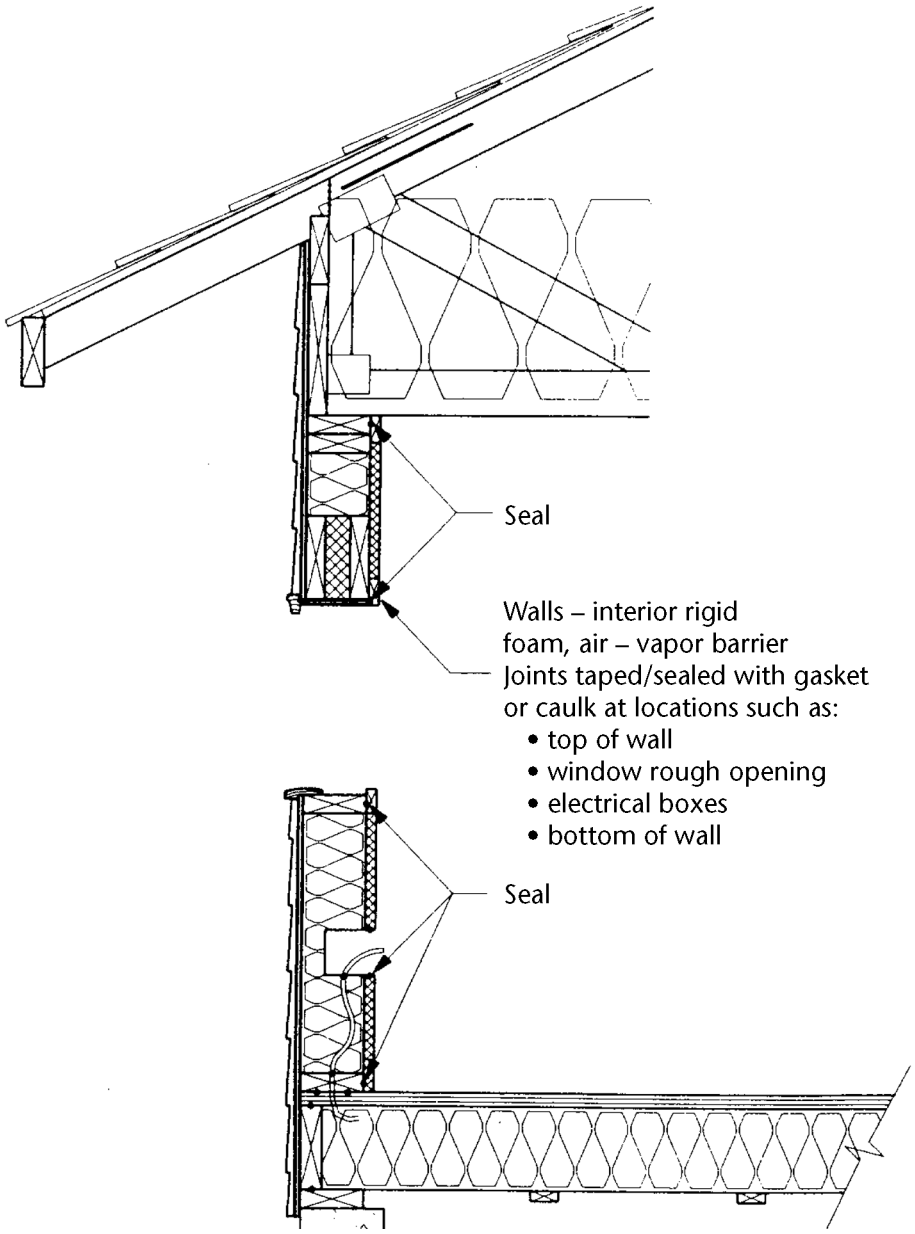


Figure 3-10

Interior Rigid Foam Framing Details

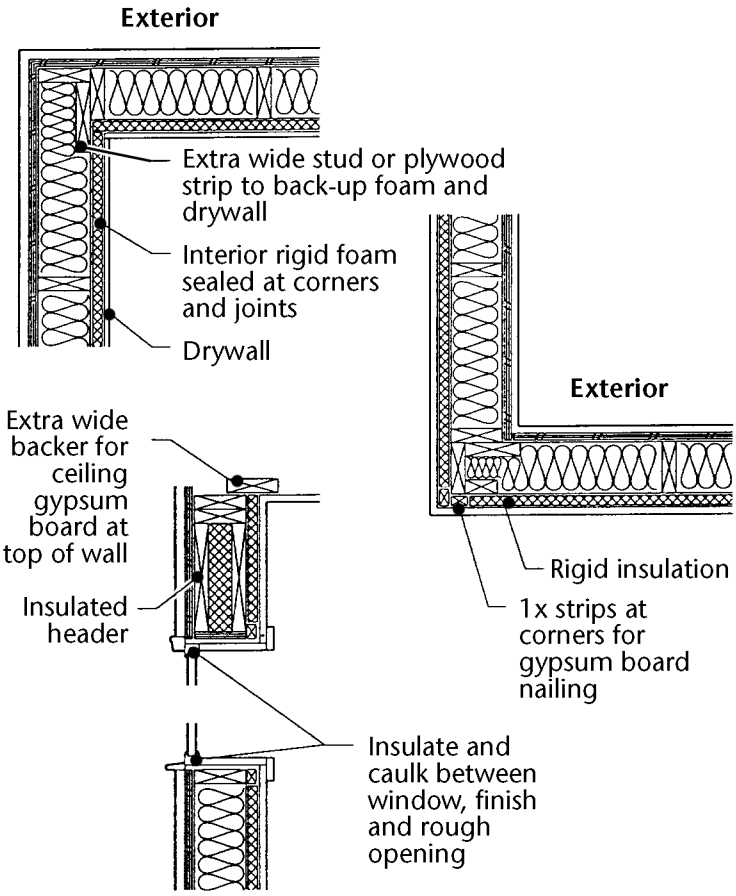


Figure 3-11a

Corner Trim Detail for Exterior Rigid Insulation

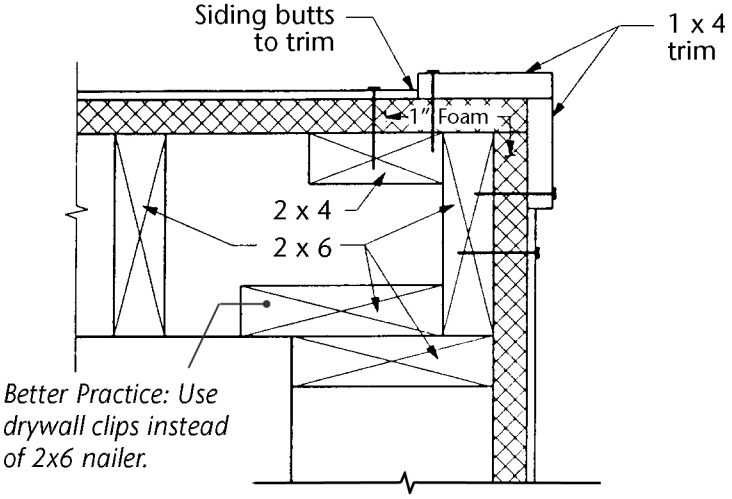


Figure 3-11b

Door Reinforcement for Exterior Rigid Insulation

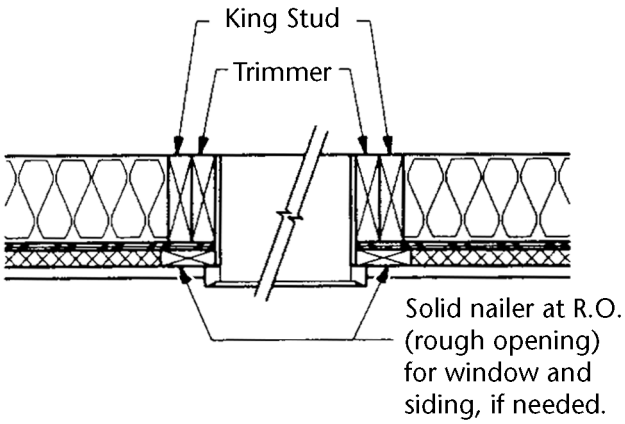
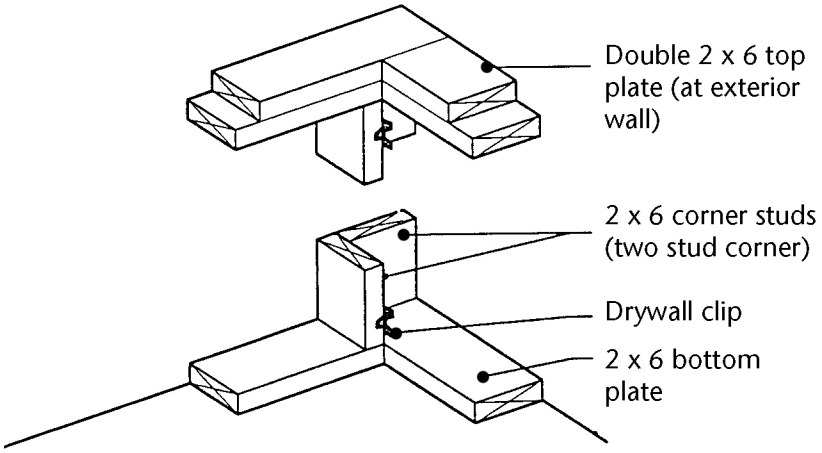


Figure 3-12

Optional Details Allowing Easy Placement of Insulation - 1

Two Stud Corner – Preferred Option



Modified Corner

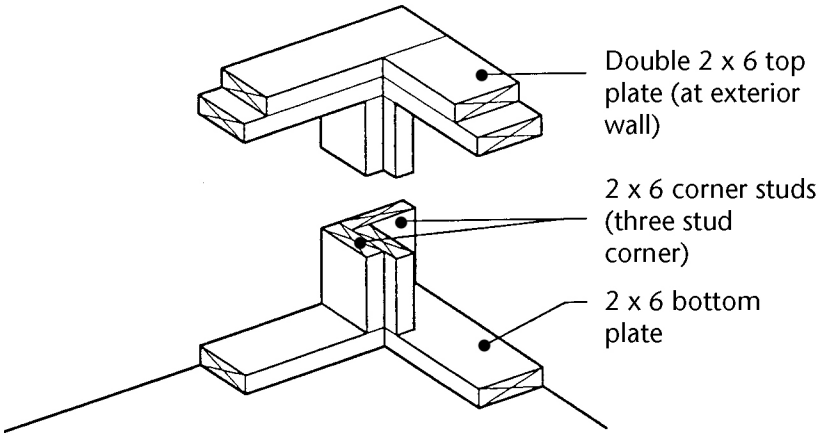


Figure 3-13

Optional Details Allowing Easy Placement of Insulation - 2

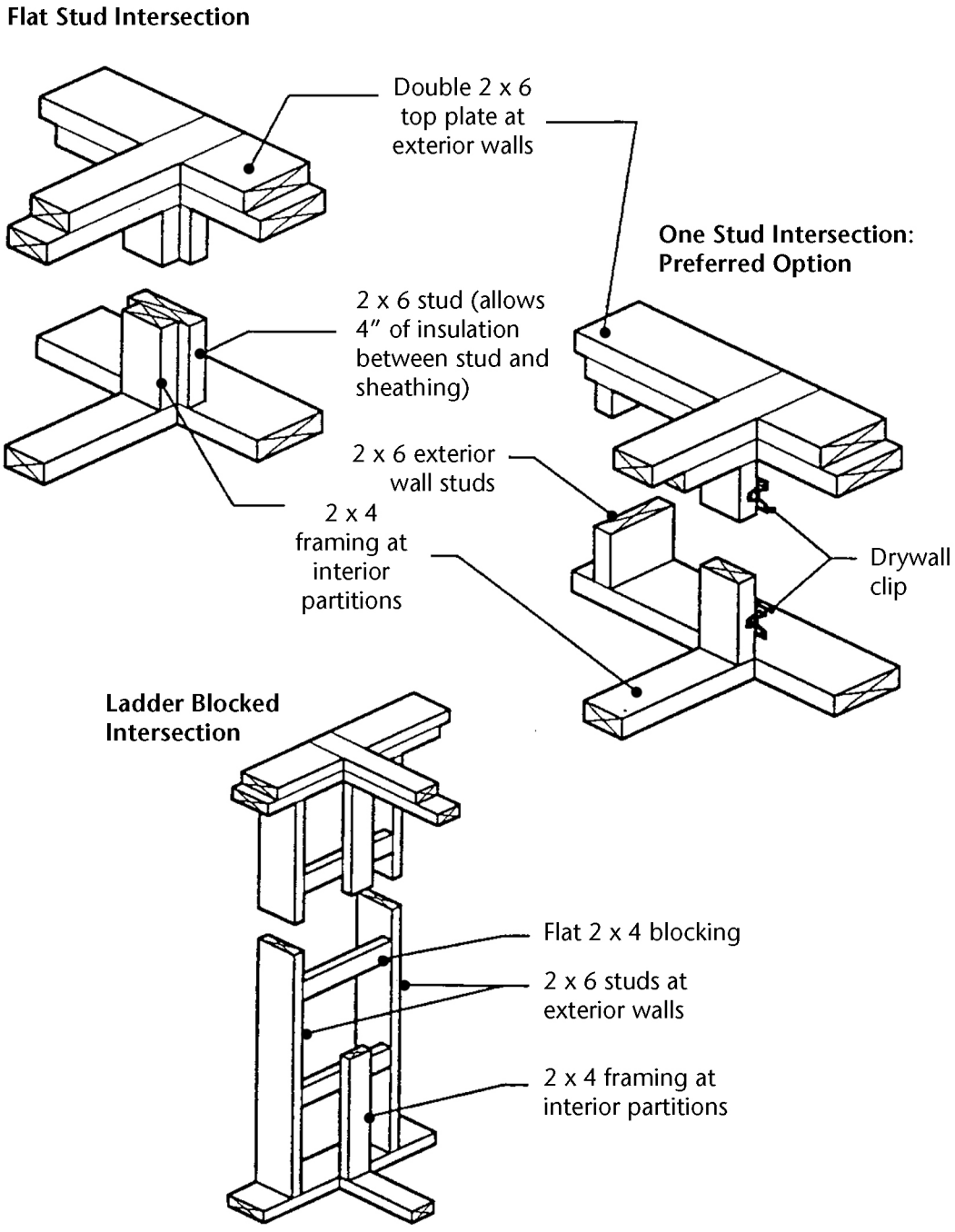
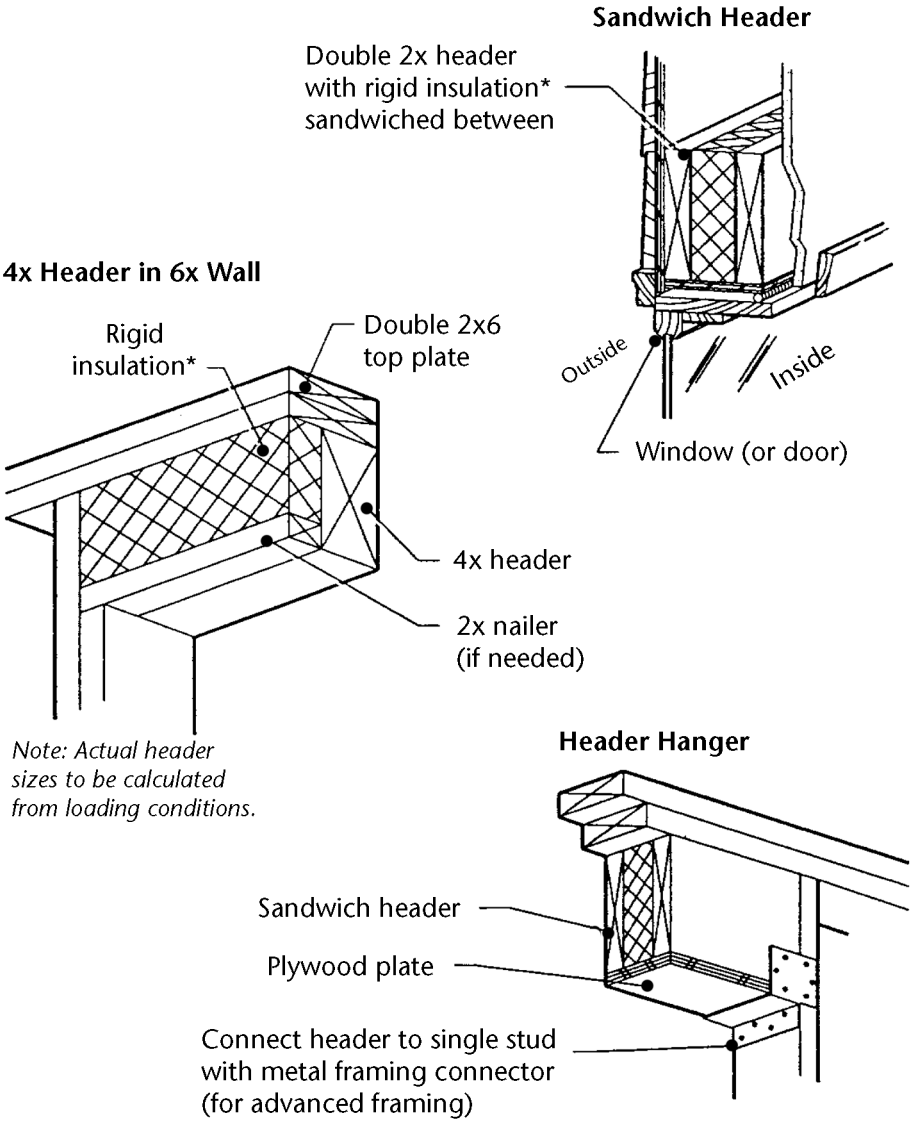


Figure 3-14

Header Details

(Required for Intermediate and Advanced Framing)



** Rigid insulated headers (R-10) required for intermediate and advanced framing.*

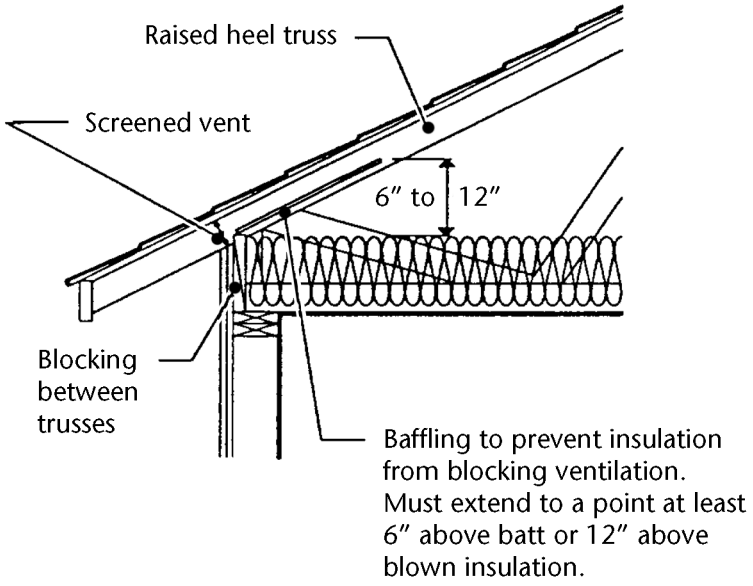
Advanced Framing. An oversized or raised heel truss replaces the standard truss to avoid compressing insulation at the exterior wall (see Figure 3-15).

Figure 3-15

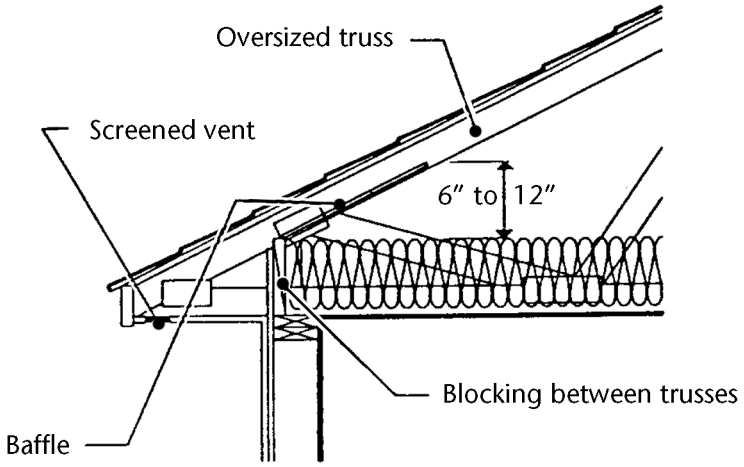
Options to Maintain Full Heel Insulation

(Advanced Frame Ceiling)

Full Insulation



Full Insulation



[502.1.4.3, 502.1.4.5]

Attic Venting. Venting must meet IRC requirements. When venting is placed at the eaves, special consideration must be given to baffling the insulation in order to maintain a minimum 1 inch of free area for air movement from the vent into the attic (see Figure 4-4).

Exception for Attic Venting

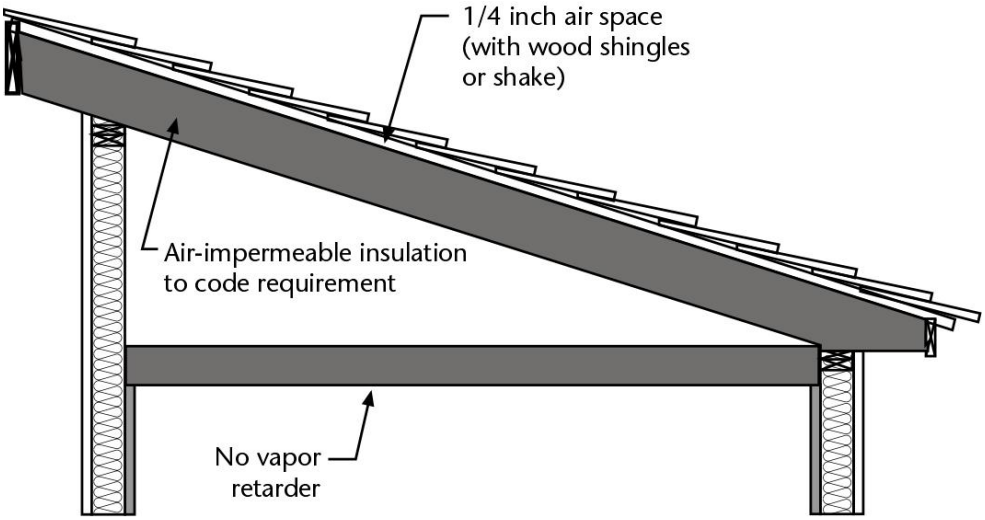
The WSEC allows an unvented attic under certain conditions. Unvented attics are created when a spray foam insulation product is applied directly to the underside of the roof sheathing or when rigid board insulation is installed directly over the structural roof sheathing. It is critical that Code requirements are met to avoid potential moisture problems, including:

- The unvented attic space is completely contained within the building thermal envelope.
- No interior vapor retarders are installed on the ceiling side (attic floor) of the unvented attic assembly.
- Where wood shingles or shakes are used, a minimum 1/4-inch (6 mm) vented air space separates the shingles or shakes and the roofing underlayment above the structural sheathing.
- Any air-impermeable insulation shall be a vapor retarder, or shall have a vapor retarder coating or covering in direct contact with the underside of the insulation, unless regid insulation board is install over the structural roof sheathing.

There are three methods for constructing unvented attic spaces. With all three methods, it is important to check that the insulation's listing allows it to be installed to the prescriptive required R-value. If not, a Component Performance or Systems Analysis Approach must be used. Also check the listing to see if a fire retardant material needs to be applied to the exposed insulation. Figure 3-16 shows the installation of air-impermeable insulation installed directly to the underside of the roof deck. This typically requires a closed cell product.

Figure 3-16

Air-Impermeable Insulation Only, In Direct Contact with Roof Sheathing



The second method shown in Figure 3-17 is used when applying an air-permeable product directly to the underside of the roof decking. This method requires rigid board or sheet insulation on the top of the roof deck. The required R-values of the rigid insulation are R-10 in Climate Zone 1 and R-25 in Climate Zone 2.

The third method is used when combining air-impermeable and air-permeable insulation (see Figure 3-18). This is sometimes referred to as a "hybrid" system. Air-impermeable insulation is applied directly to the underside of the roof deck. As with the previous method, the air-impermeable insulation must be installed to a minimum of R-10 in Climate Zone 1 and R-25 in Climate Zone 2. Air-permeable insulation may now be installed to reach required R-values.

Figure 3-17

Air-Impermeable and Air Permeable Insulation Interior

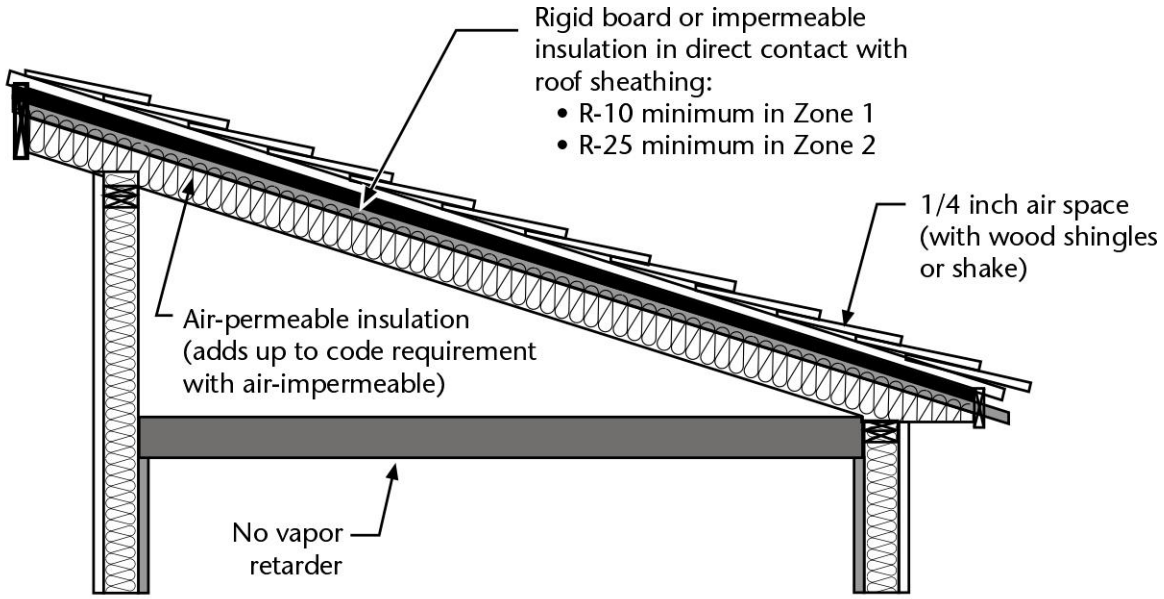
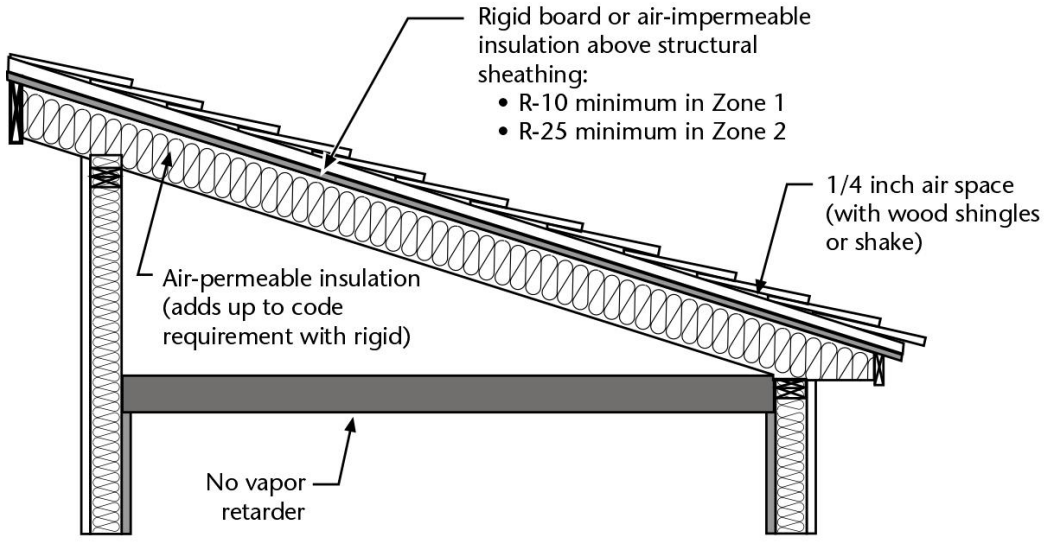


Figure 3-18

Air-Permeable Insulation Interior, Air Impermeable Exterior



Vaulted Ceilings*. Following some prescriptive paths, single rafter vaults require R-38 insulation. Component performance compliance may allow less than R-38 if another component makes up the difference (see Chapter 5). Various options for framing vaulted ceilings to obtain high levels of insulation are available (see Figure 3-19).

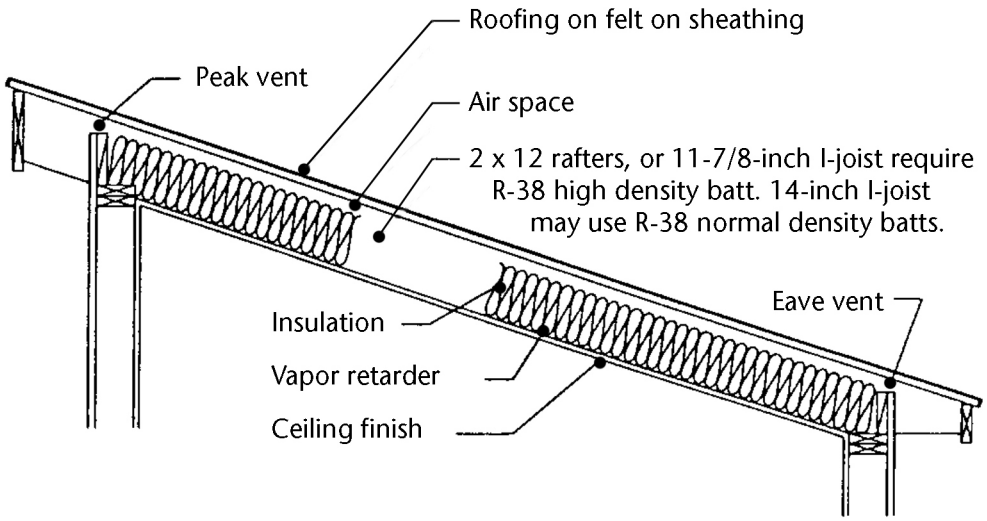
** A vaulted ceiling is defined as a ceiling where enclosed joist or rafter space is formed by ceilings applied directly to the underside of roof joists or rafters. A sloped ceiling of a scissor truss is not considered a vaulted ceiling.*

[502.1.6.3] **Vault Cavity Ventilation.** Most ceilings with insulation beneath the structural sheathing, including vaults, must provide a minimum 1-inch air space above the insulation (see Figure 3-20).

Figure 3-19

Vaulted Ceilings

Stick Frame (R-38)



Flat Truss (R-38/R-60)

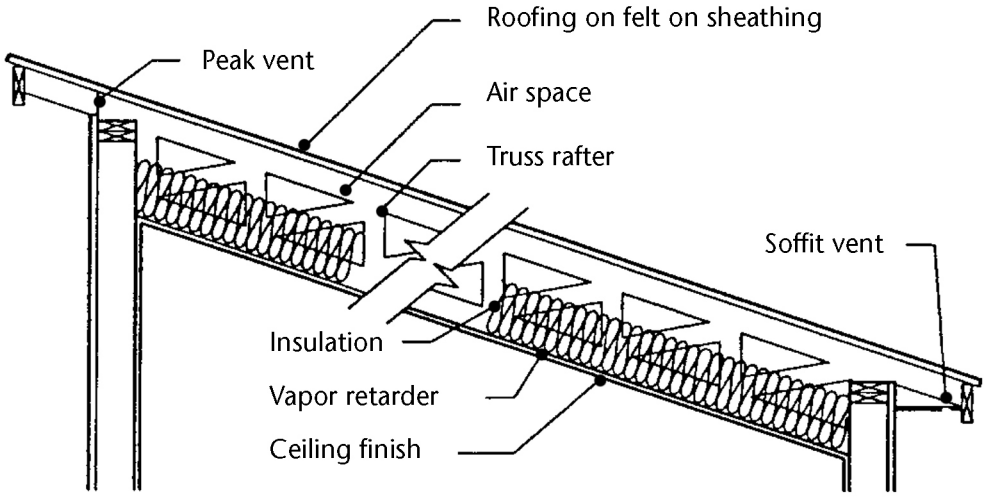
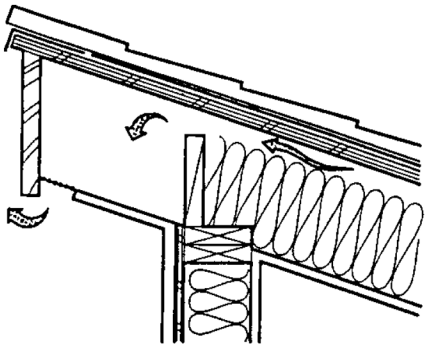
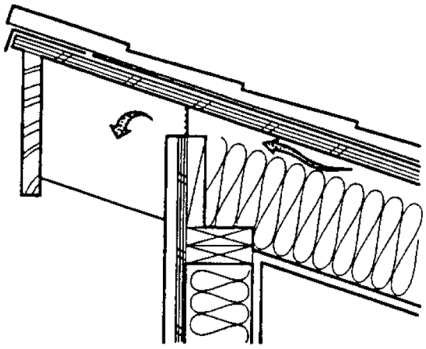


Figure 3-20

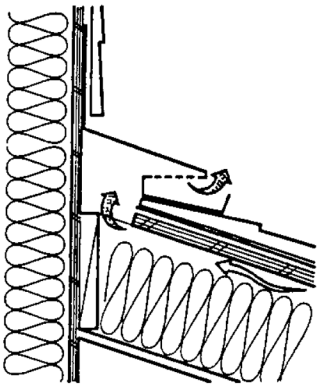
Venting Vaulted Ceilings



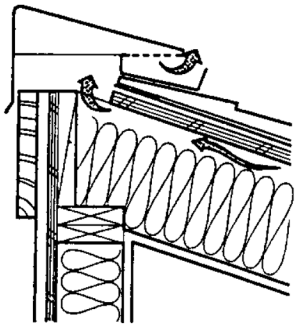
Shed Peak With Soffit



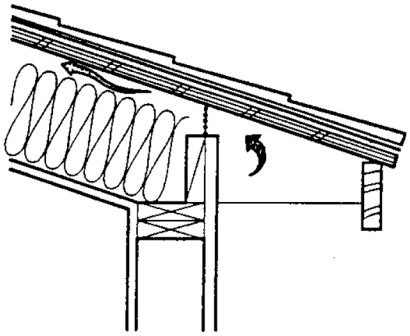
Shed Peak Without Soffit



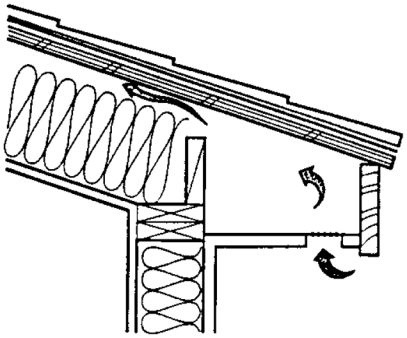
Shed Roof at Wall



Shed Peak: No Overhang



Eave Without Soffit



Eave With Soffit